

# SlidePacer

## Improving Class Pace for Deaf and Hard-of-Hearing Students

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**Abstract**—Following multimedia lectures in mainstream classrooms in university education is challenging for deaf and hard-of-hearing (DHH) students even when they are provided accommodations to best address their individual needs. Due to multiple visual sources of information (teacher, slides, interpreter, blackboard), these students struggle to divide their attention among several simultaneous sources of input, which may result in their missing important parts of the lecture content; as a result, DHH students' access to information can be limited in comparison to that of their hearing peers, and so their academic achievements may be impacted. This paper introduces SlidePacer, a tool aimed at improving coordination between the instructor's speech, the sign language interpretation of the lecture and the slide projection change. The goal of this software is to prevent DHH students' loss of information by promoting an adequate pace of the lecture, which can contribute to their learning and academic achievements. We conclude with discussion of future work.

**Keywords**— *deaf and hard-of-hearing; learning; pace; lecture; presentation; interpreter; multimedia; visual sources*

### I. INTRODUCTION

There has been an increasing number of deaf and hard-of-hearing (DHH) students in college in the United States since the Individuals with Disabilities Education Act (Public Law 101-476) was announced in 1990 [6]. Students have access to different classroom accommodations that can provide DHH students the opportunity to follow the lectures. These access services consists of captions, sign language interpretation, and/or note taking depending on a student's needs or preference. Despite the availability of these services, DHH students still struggle to achieve an academic performance equal to that of their hearing peers [3]. One potential source of contribution to this struggle is that DHH have to switch their attention among different sources of information in the classrooms (teacher, slides, blackboard, captions or interpreter). This switching of attention from one source of information to another is likely to result in the loss of important content thereby affecting DHH students' academic performance. As students move their eyes from one visual input to another, they arrive at the content (lecture, slides, captions, and interpreters) at different points, thus not getting a complete input message from any of the sources.

Not all instructors who base their lectures on slides presentations are aware of the challenges their DHH students face to follow the content in mainstream classrooms, let alone of what could be done to support these students to better follow their lectures.

The present work introduces SlidePacer as an assistive tool for those instructors that use PowerPoint slides in their classes and count on interpreters to provide sign language interpretation for their DHH students. As sign language interpreters must, of necessity, lag somewhat behind the lecturer, it is common for the interpreter and the slides to get out of sync. This has obvious potential for confusing DHH students and also means that these students will be unable to fully process the slides and/or sign language interpretation if trying to visually process both at the same time. The goal of SlidePacer is to keep the pace of slide presentation in sync with that of the sign language interpreting so that DHH students will have time to process different input, one at a time.

In this paper, the SlidePacer software is introduced and a formative evaluation is presented. Future work is outlined, based on this evaluation.

#### A. Related Work

Previous research focused on assistive technologies for DHH students to manage multiple visual sources by integrating multiple views in a single screen or directing their attention to changes [1, 4, 5, 7]. However, students still have to integrate multiple visual sources of information, which overloads working memory and impacts their learning [2].

#### B. SlidePacer

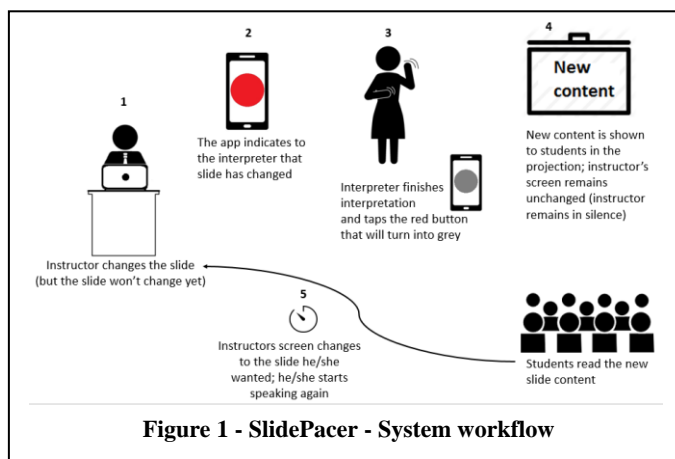
SlidePacer is a software comprised of two parts: a) a PowerPoint add-in to be used by the instructor, and b) an Android application to be used by the interpreter. The instructor's computer and the interpreter's smartphone are connected by Bluetooth.

The SlidePacer workflow was designed so that throughout a lecture the instructor indicates the end of his or her presentation about each slide, by giving the typical PowerPoint command to advance to the next content. The PowerPoint add-in communicates with the Android app, to

signal to the interpreter that the presentation for the current slide is completed. And once the interpretation for that segment of the lecture is finished, the interpreter should interact with the app to actually advance the slide. This app, designed to be used by the interpreter, is an Android application that has one single screen with a big circular button which turns red or gray depending on the status of the system workflow: red indicates to the interpreter that the instructor wants to change the slide and now is waiting for the interpretation to be finished, while grey indicates that instructor has not changed slide yet, lecturer is speaking and interpretation continues.

Once instructor has given the command to move to the next slide and so the button in the app turns red, the interpreter taps the red button as soon as his/her sign language interpretation is finished. This action will advance the slide on the projection panel for the students who are given a few seconds to look at the new content. This next slide is not available on the instructor's computer yet, once the instructor's screen shows a waiting sign indicating that students are given some time to read the slide content before s/he starts talking again. Following this, the new slide will be visible on the teacher's screen as well, so he/she can start speaking again. The button on the Android app remains grey during slide transition, when the instructor is speaking, and during interpretation.

The SlidePacer workflow mentioned above can be seen in Figure 1 that shows, from left to right: 1) Instructor changes the slide (but the slide in his computer will not be changed yet); 2) this change in 1 immediately makes the App with interpreter sign a red button; 3) interpreter finishes interpretation and taps the red button; the button turns grey waiting for the next cycle of change; 4) new content is shown on the projection panel for all students in the classroom so they can see the new slide for a set few seconds; 5) after these seconds, the slide in instructor screen is also changed; instructor starts speaking again, and instructor and students are in the same slide.



**Figure 1 - SlidePacer - System workflow**

## II. EVALUATION

Prior to an experimental study that is currently underway, SlidePacer was informally shown in separate sessions to two instructors and three interpreters at the Rochester Institute of Technology (RIT):

### A. Interpreters' feedback

The focus group session with interpreters counted on 3 experienced RIT interpreters who were indicated to attend by the National Technical Institute for the Deaf (NTID). This session has started by discussing which would be the challenges DHH students face in mainstream classrooms, and what could be done to address those challenges in these interpreters' point of view. During this collaborative discussion, interpreters have suggested that instruction could be improved by waiting for the interpretation to finish before transitioning to another topic or slide. This specific suggestion matches the objective of SlidePacer which is to improve pacing behavior in classrooms.

Later on during this session with the interpreters, the SlidePacer was shown in a mock-lecture setting with no students. The instructor speech was simulated by one of the present investigators, and one of the interpreters was asked to sign for that lecture and interact with the app to change slides.

When asked about if adapting the pace of the lecture would support DHH students' needs, all of them mentioned that it would definitely be beneficial. In addition, they suggested and agreed that SlidePacer could either be advantageous to hearing students, since some slides can be dense or full of information.

Considering the use of the app, the interpreters mentioned that their activity in classroom should be as unobtrusive as possible, and suggested that the control of slide changing should be given directly to students. In addition, interpreters indicated that the button in the app interface could be a source of distraction for the students once the smartphone would be placed between interpreters and students. This position, therefore, would grab not only interpreters' but students' attention as well. Hence, investigations regarding the implementation of tactile SlidePacer feedback in a smart watch are currently underway, as an alternative to the use of smartphone.

### B. Teachers' feedback

A similar focus group session was planned with slightly different questions due to the different roles interpreters and instructors perform in classrooms.

Three instructors of the Thomas Golisano College of Computing and Information Sciences at RIT were invited and two of them could attend the session. These instructors had prior experience in teaching both hearing and DHH students in their classes, however these teachers have different class formats: one consistently uses PowerPoint and the other uses few slides since his classes are mostly based on group discussions.

One of these attendees were also asked to use SlidePacer. One of them was given a mock PowerPoint presentation slides

to talk about their own bio, once this topic would not require previous preparation. One of the investigators interacted with the app to simulate the actions that would be done by an interpreter.

After this hands on experience, both teachers agreed that SlidePacer might be beneficial to DHH students, but at the same time they suggested that forcing a change of pace would interfere with the rhythm of the lecture and, hence, the instructors' flow of thoughts. One of the instructors, who has American Sign Language (ASL) skills, commented that he already tries to wait for the interpretation to finish before he changes slides once he knows the DHH students might lose information if he continues without them have finished watching the interpretation. It was also pointed out that users of computer devices are likely to expect immediate feedback after a command is given, and so he complemented it would be interesting to investigate how instructors would deal with the waiting time after they give the command to advance the slides.

Instructors agreed that the SlidePacer could also be used as a pace teaching tool, once using SlidePacer a couple of times could be helpful to instructors to get accustomed to an adequate pace of the lecture. This potential of SlidePacer as training tool should be evaluated in future studies.

### III. CONCLUSION

This paper introduced SlidePacer as a potential tool to be used by instructors and interpreters to collaboratively advance slides to students in classroom; in addition, SlidePacer could be also used as a learning tool by the instructors that would like to promote better pacing behaviors in their classroom to best attend DHH students' needs.

The aim of SlidePacer is to provide DHH students the opportunity to follow the information in class without missing important content by looking at each source, interpreter or slides, at a time, therefore improving these students' academic achievements.

As indicated by the focus groups sessions that were held to gather feedback about the tool, SlidePacer can also be beneficial for hearing students.

### IV. FUTURE WORK

This paper has presented the SlidePacer system, its workflow and the two groups of involved stakeholders that would interact with the system: teachers and interpreters. These stakeholders were generally positive of the goals, although did suggest some changes. We will use these changes to iteratively design and again evaluate SlidePacer with these

stakeholders. In these future evaluations we aim i) to identify instructors' needs to be taken into account to better address their challenges when dealing with SlidePacer, and ii) to identify which improvements should be made to SlidePacer in order to render the interpreters' activity in classroom as unobtrusive as possible.

The ultimate test of the success of this SlidePacer, however, will be whether it improves learning for DHH students using sign language interpreters in a mainstream university environment. To this end, assuming supportive evaluations by instructors and interpreters, we are currently carrying out an experimental study to measure lecture comprehension in classrooms with and without SlidePacer, considering participation of both hearing and DHH students. To be successful, SlidePacer will need to be easily accepted and used by both lecturer and interpreters, improve lecture comprehension for DHH students, and cause no decrements in learning for hearing students. Future work will tackle each of these issues.

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